

CH 20: THE CARDIOVASCULAR SYSTEM: **BLOOD VESSELS**

Key Concepts:

- ❶ Describe the histological similarities and differences of the blood vessels
- ❷ Explain the pattern and names of the major arteries and veins of the pulmonary & systemic circulations
- ❸ Describe the circulatory changes that occur at birth.

The Circuits

Pulmonary Circuit:

From the “Right Heart” to the Lungs

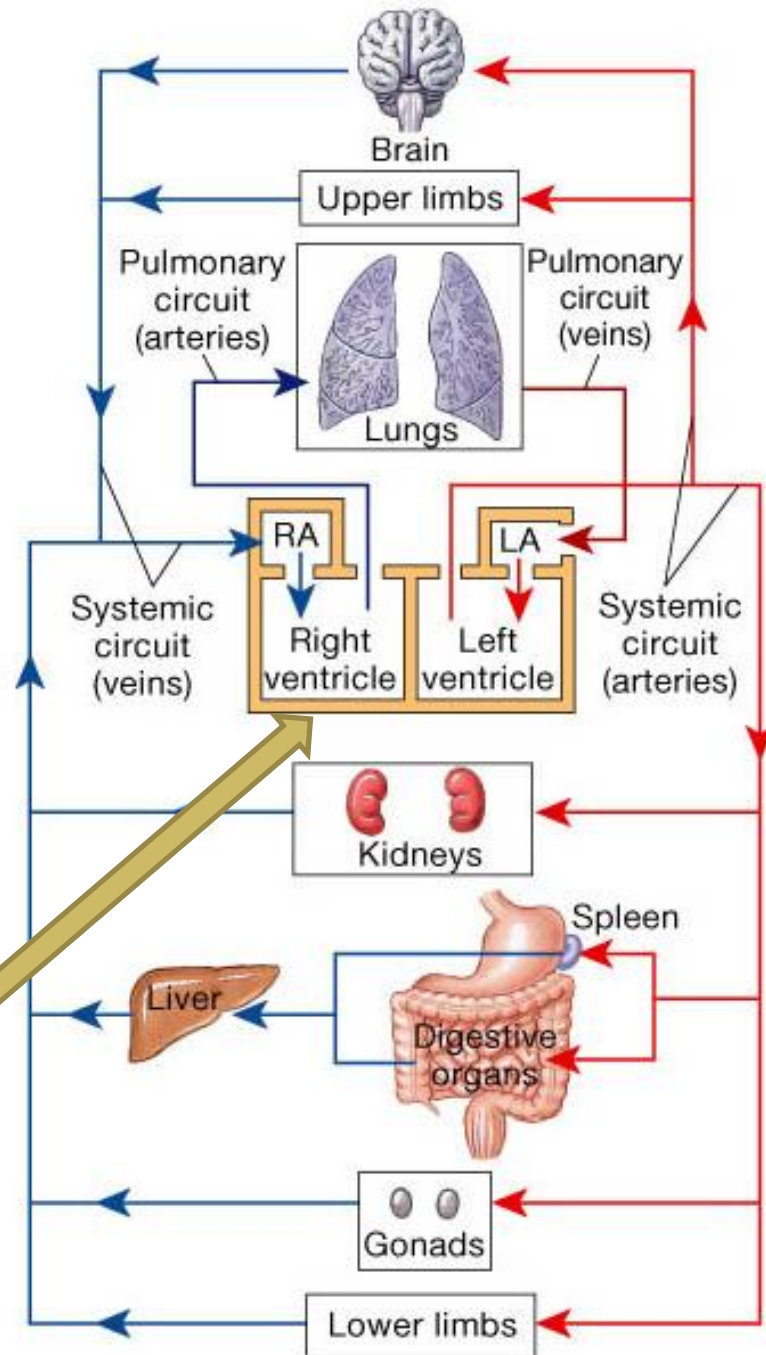
Systemic Circuit:

From the “Left Heart” to Everywhere Else

65 -70% in veins (= blood reservoir); lumen is larger than in corresponding arteries

30-35% in heart, arteries and capillaries

N.B. The chambers pump the same VOLUME, approx 35 cc.



Histology of Blood Vessels

1. Tunica interna or intima (endothelium + c.t.)
2. Tunica media (muscle + c.t.) Much more smooth muscle in arteries
3. Tunica externa or adventitia (thick layer of c.t.)
4. Vasa vasorum (p 588)



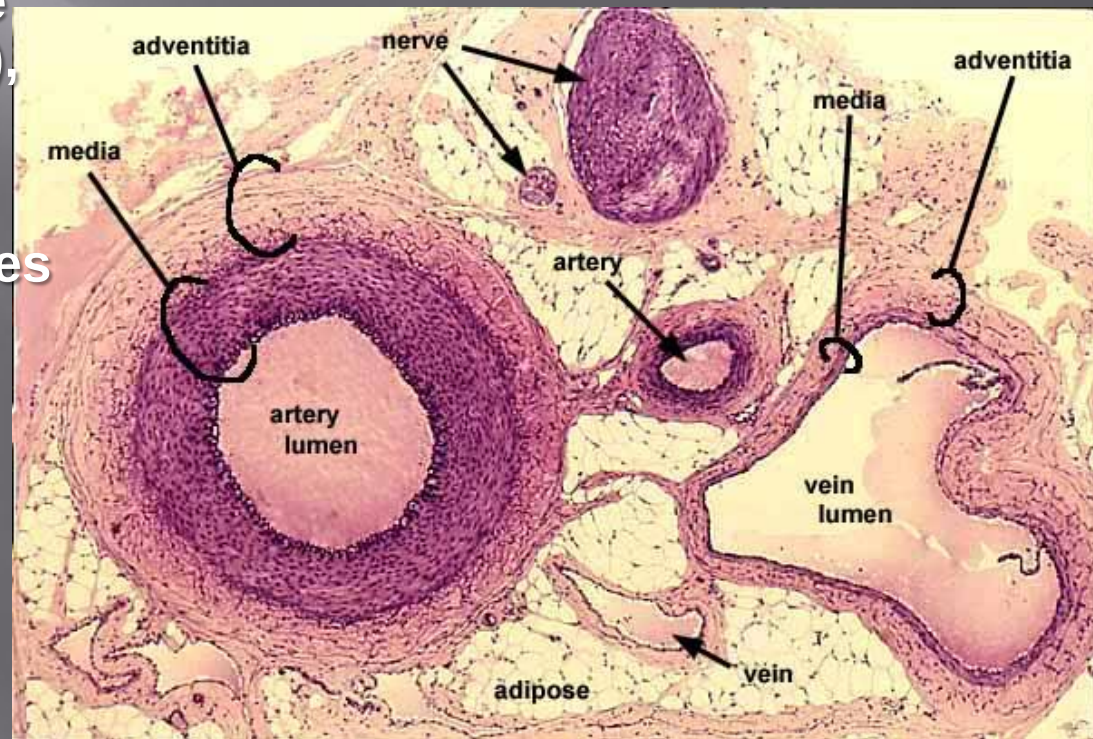
Histology of Blood Vessels

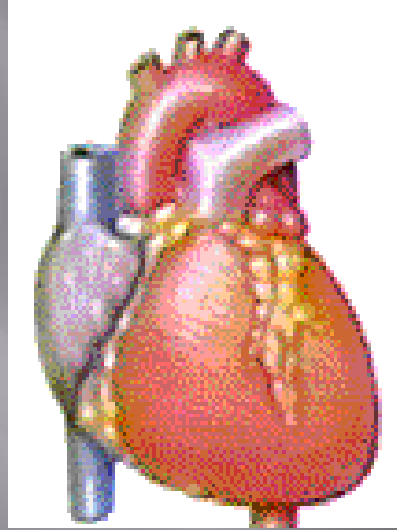
Distinguishing Arteries from Veins:

- **Artery** walls thicker (more muscle and elastic fibers), smaller lumen
- Additional: internal & external elastic membranes

Artifacts when fixing slides:

- **Arterial** walls contract; endothelium cannot contract: pleated appearance
- **Veins** collapse in fixation





large vein

medium-sized vein

venules

capillaries

elastic arteries

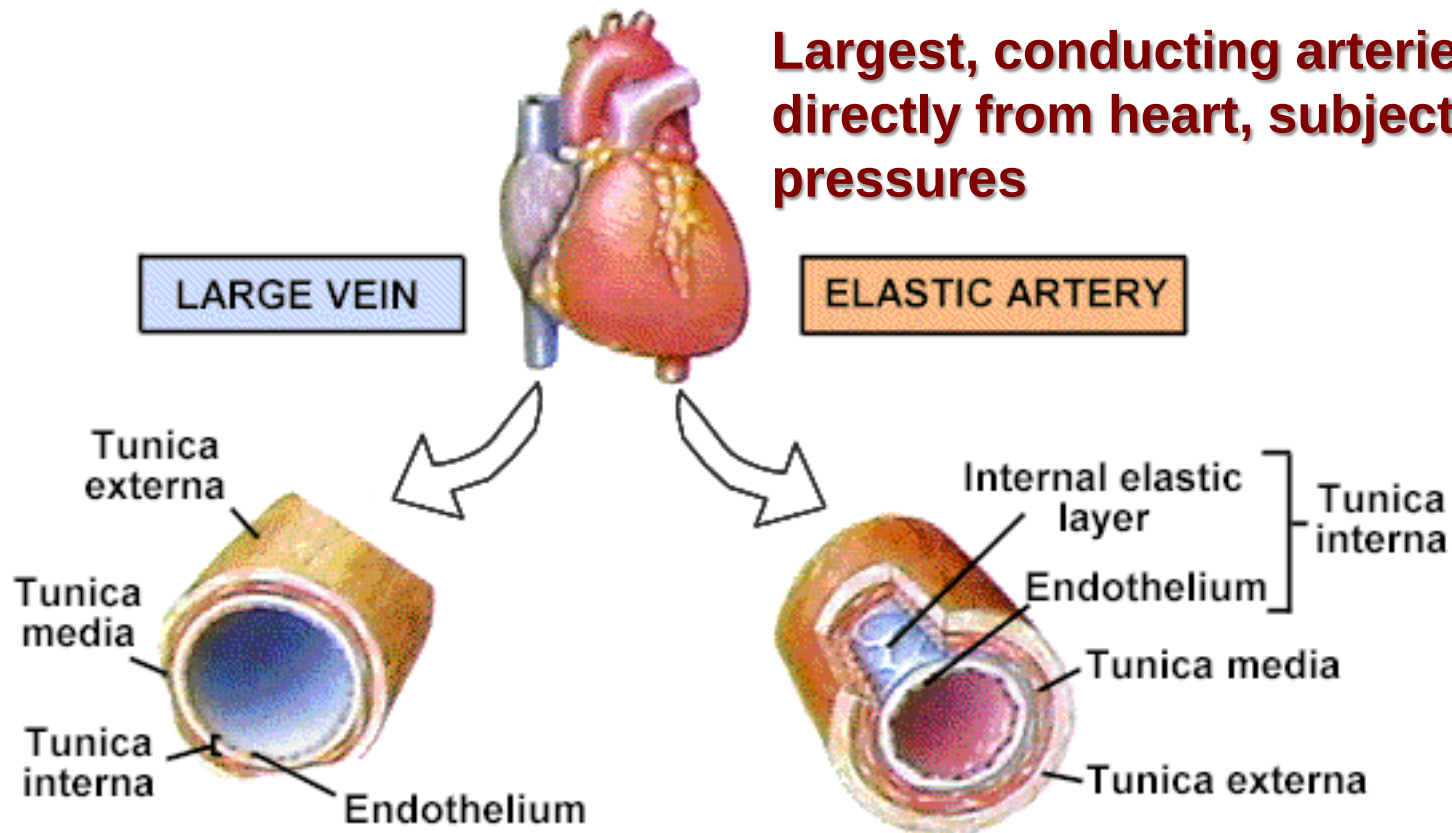
muscular arteries

arterioles

Arteries – ALWAYS carry blood away from heart

Veins – ALWAYS return blood to heart,
contain about 2/3 body's blood at any given time

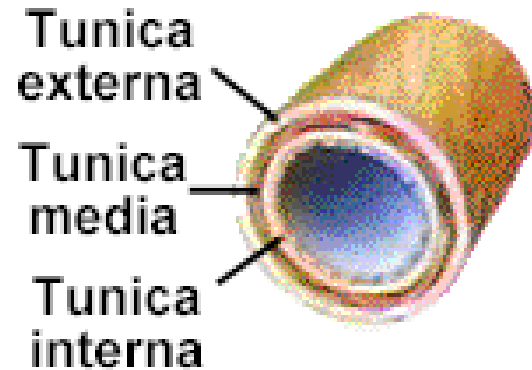
Largest, conducting arteries – lead directly from heart, subject to high pressures



Superior & inferior vena cava and their tributaries

Pulmonary trunk & aorta and their major branches

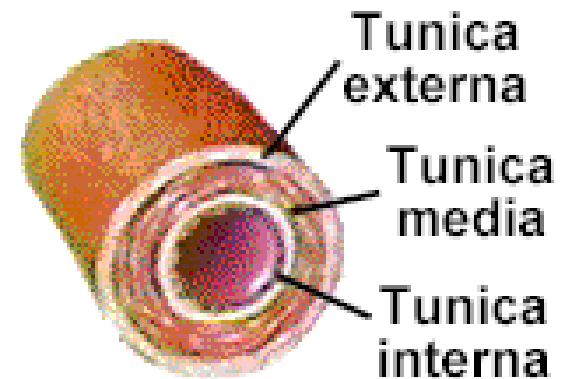
MEDIUM-SIZED VEIN



Ø 2 - 9 mm

External and internal
jugular, brachial &
femoral veins

MUSCULAR ARTERY

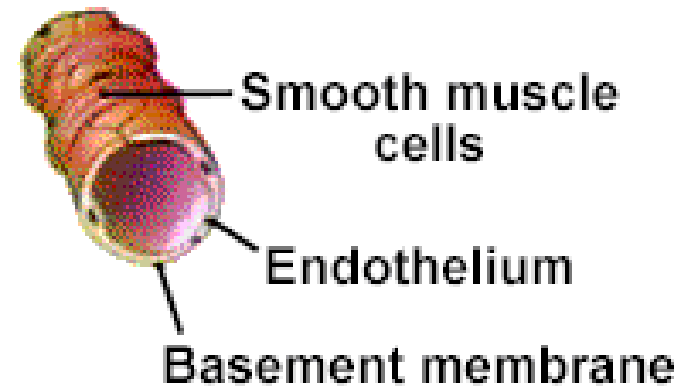
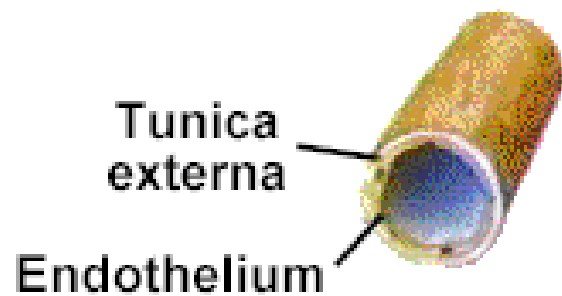


Ø ~ 4 mm

External and internal
carotids, brachial &
femoral arteries

VENULE

ARTERIOLE



Ø ~ 10-50 µm

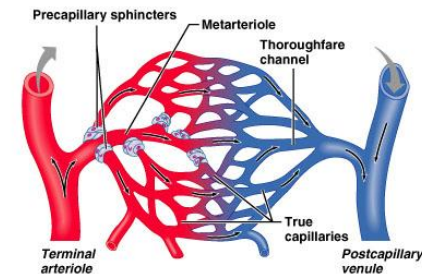
Ø ~ 30 µm

Remember: RBC ~ 7 µm

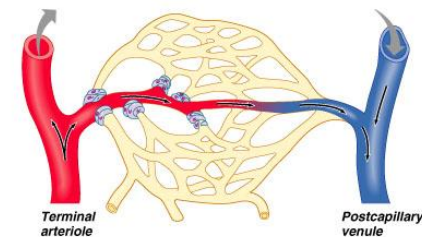
Capillaries

Fig 20.4

- ▣ The smallest
- ▣ Only vessels that allow exchange
 - Diffusion or active transport
- ▣ Precapillary Sphincters regulate flow and blood pressure



(a) Sphincters open

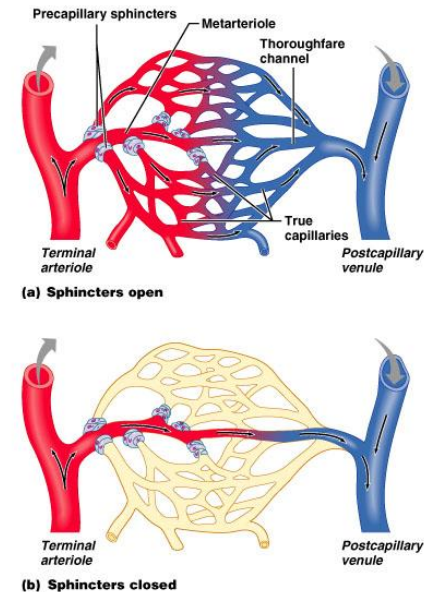


(b) Sphincters closed

Capillaries

Fig 19.3

- ▣ Simple squamous epithelium; *This kind of epithelium is sometimes called an 'endothelium' because it does not face the world outside the body*
- ▣ Continuous, fenestrated, or sinusoids
 - ▣ Permit increasing exchange
- ▣ Capillary Beds (plexuses)

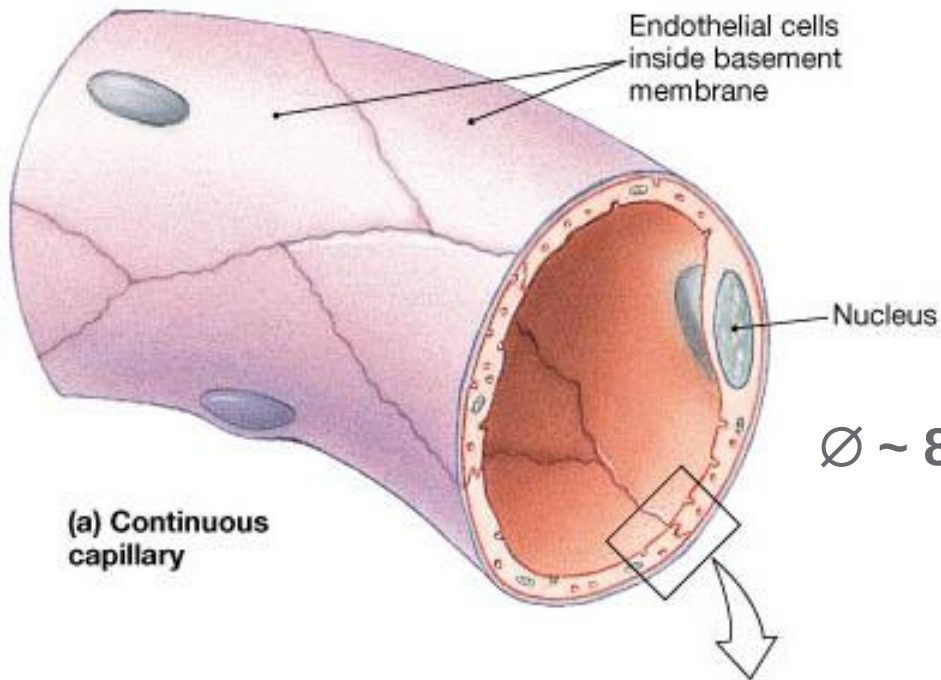


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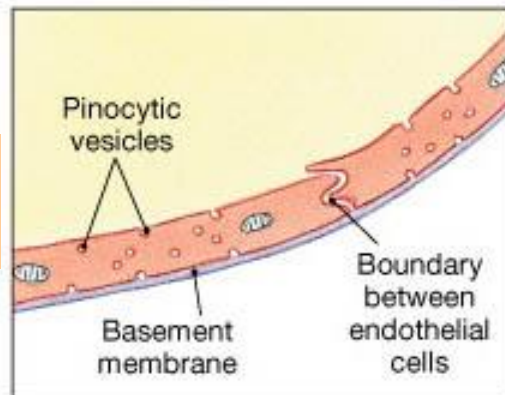
Capillary flow

Capillaries

Only endothelium
Variably permeable

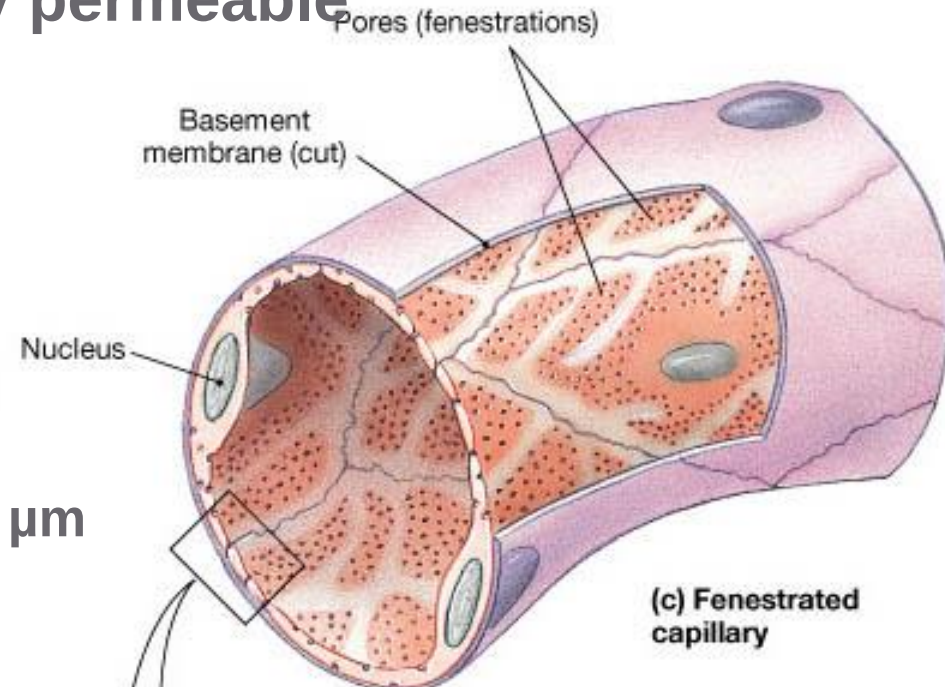


(a) Continuous capillary



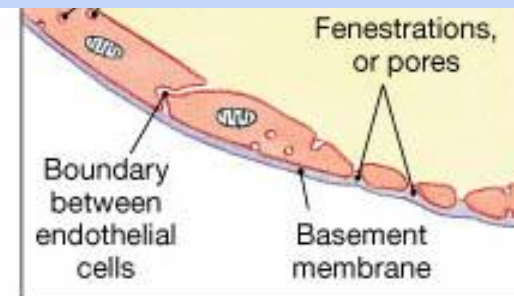
somewhat permeable

Most body regions



(c) Fenestrated capillary

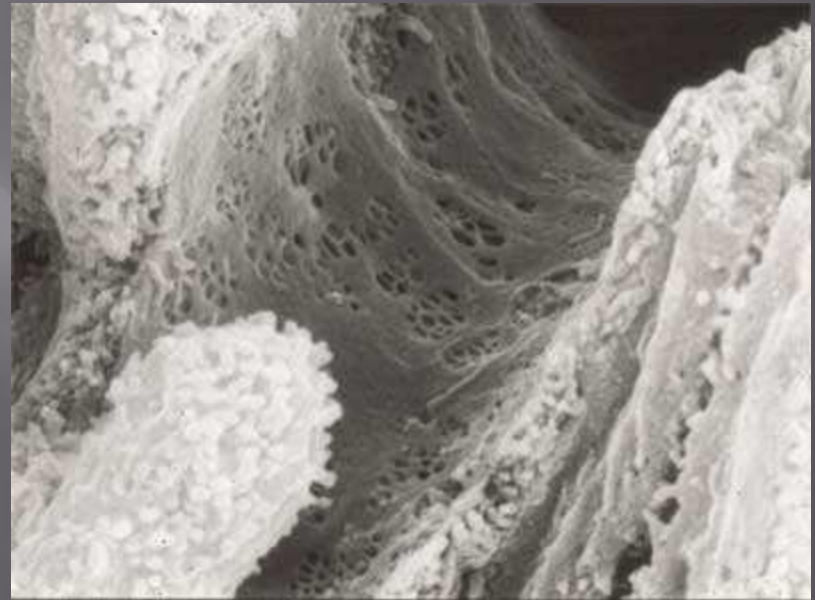
Characterized by circular fenestrations or pores that penetrate the endothelium - permit exchange of larger molecules.



Intestinal mucosa, choroid plexus, endocrine glands, kidneys

Sinusoids (sinusoidal capillaries)

- Resemble fenestrated capillaries, yet
 1. Wider than typical capillaries
 2. irregular shapes
 3. have longer, larger pores
 4. thinner (or no) basement membrane
- Blood movement very slow
- Exchange of larger molecules, i.e., proteins
- Found in the liver, bone marrow, spleen



A lymphocyte traversing a fenestrated sinusoid.

Veins

Postcapillary venule

Venule

Vein

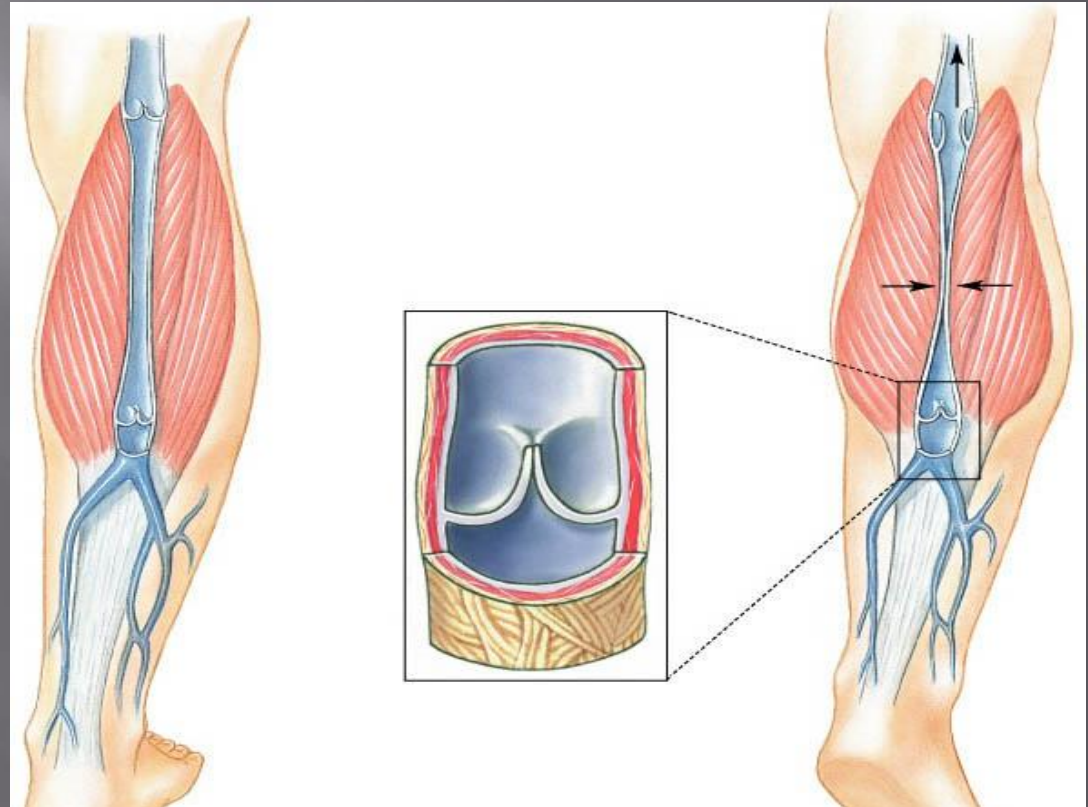
Thin wall

Large lumen

Low pressure

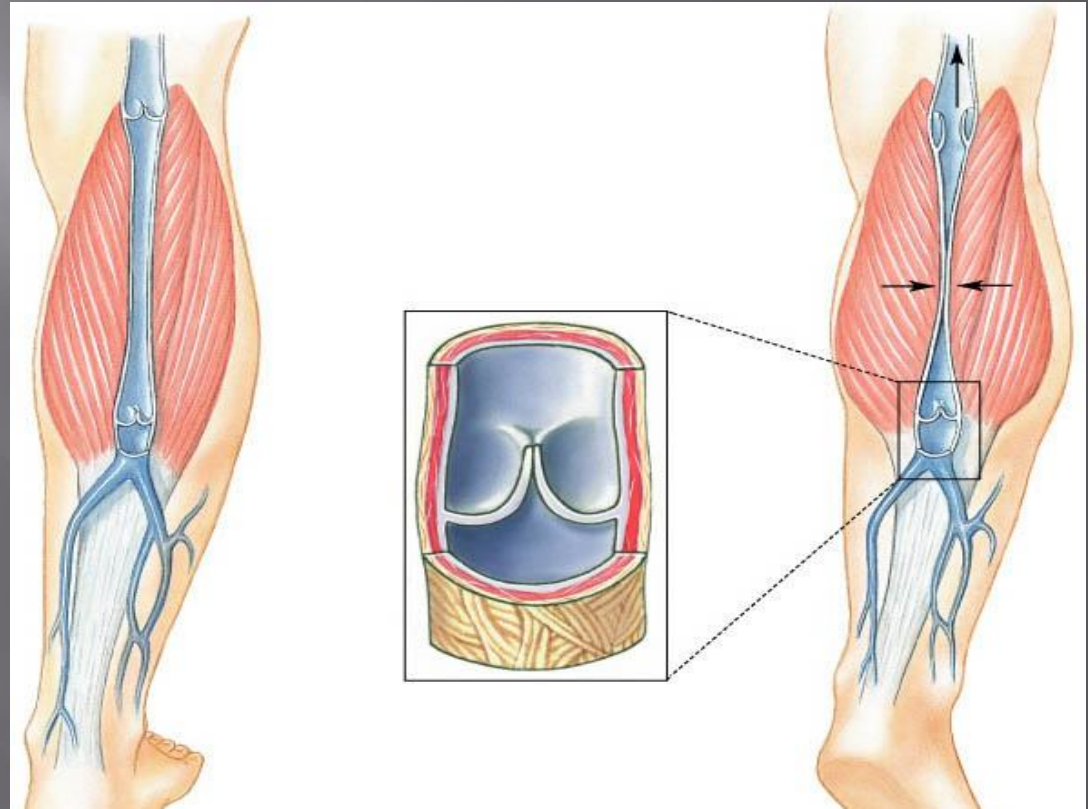
Low velocity

Valves

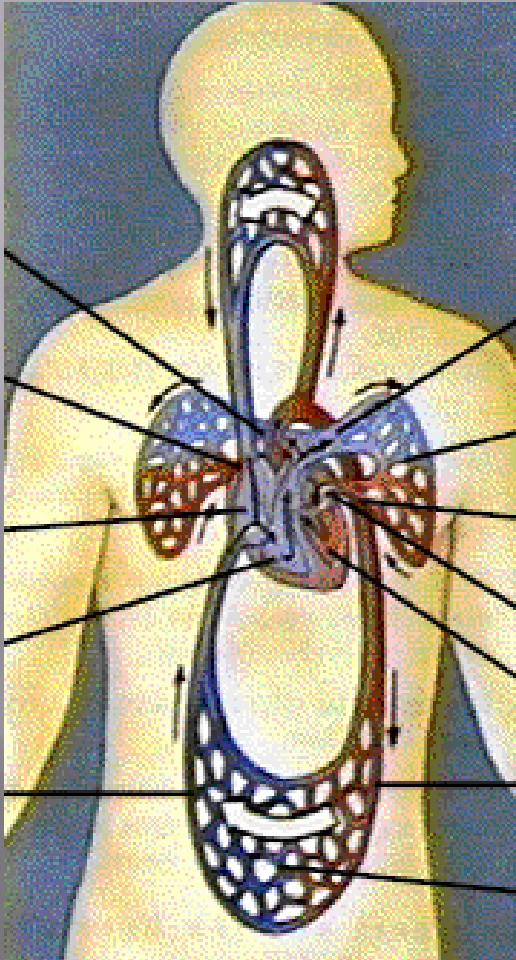


Veins

Why are valves found in veins but not in arteries?



Gross Anatomy of Circulatory System

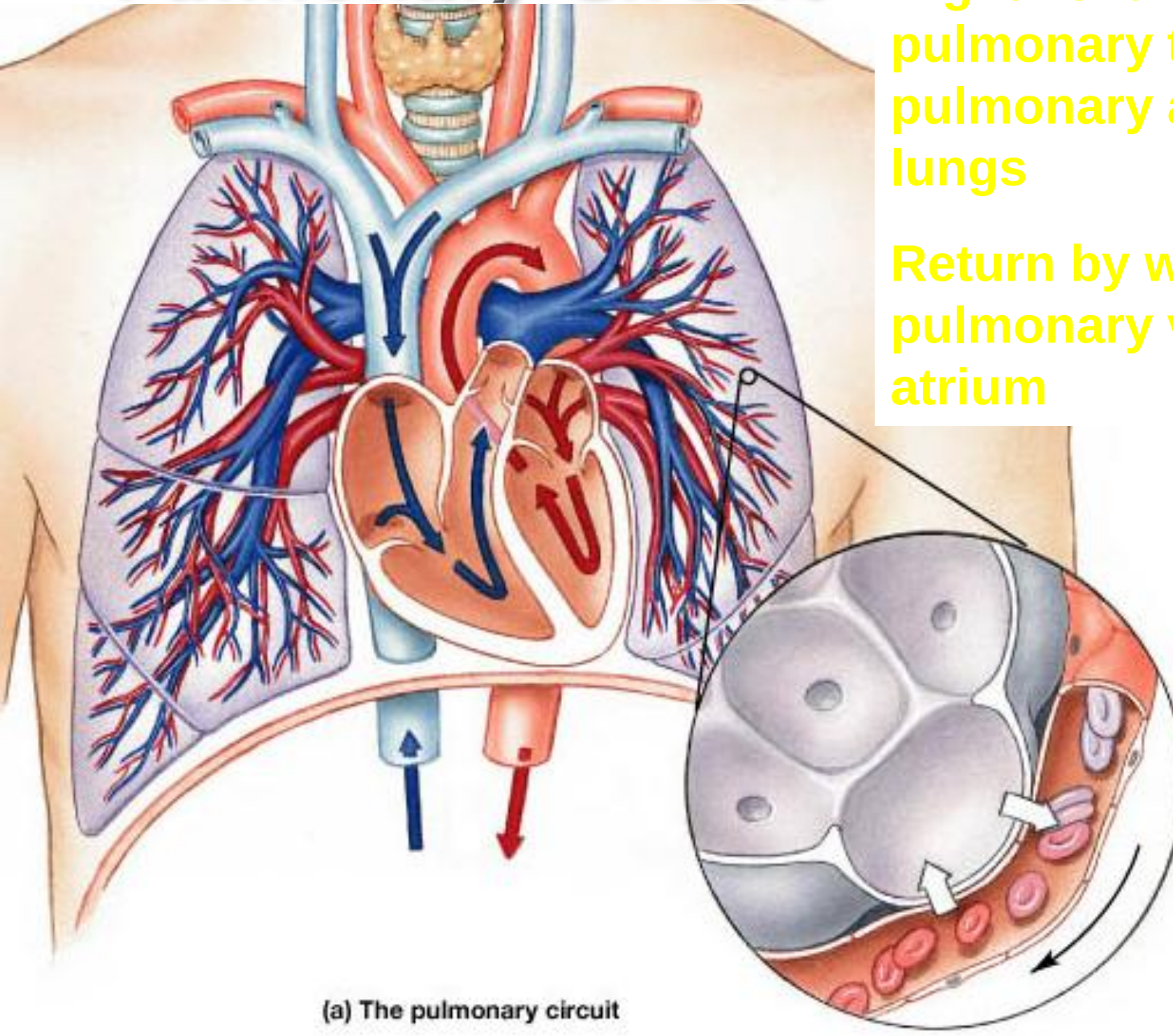


Pulmonary &
Systemic Circulations

Pulmonary Circuit

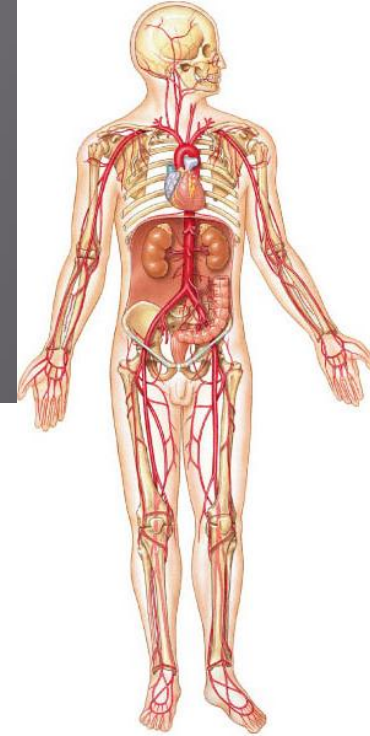
Right ventricle into
pulmonary trunk to
pulmonary arteries to
lungs

Return by way of 4
pulmonary veins to left
atrium



(a) The pulmonary circuit

Systemic Circulation



Right common
carotid artery

Thyrocervical
trunk

Right subclavian
artery

1 Brachiocephalic
trunk

Internal thoracic
artery

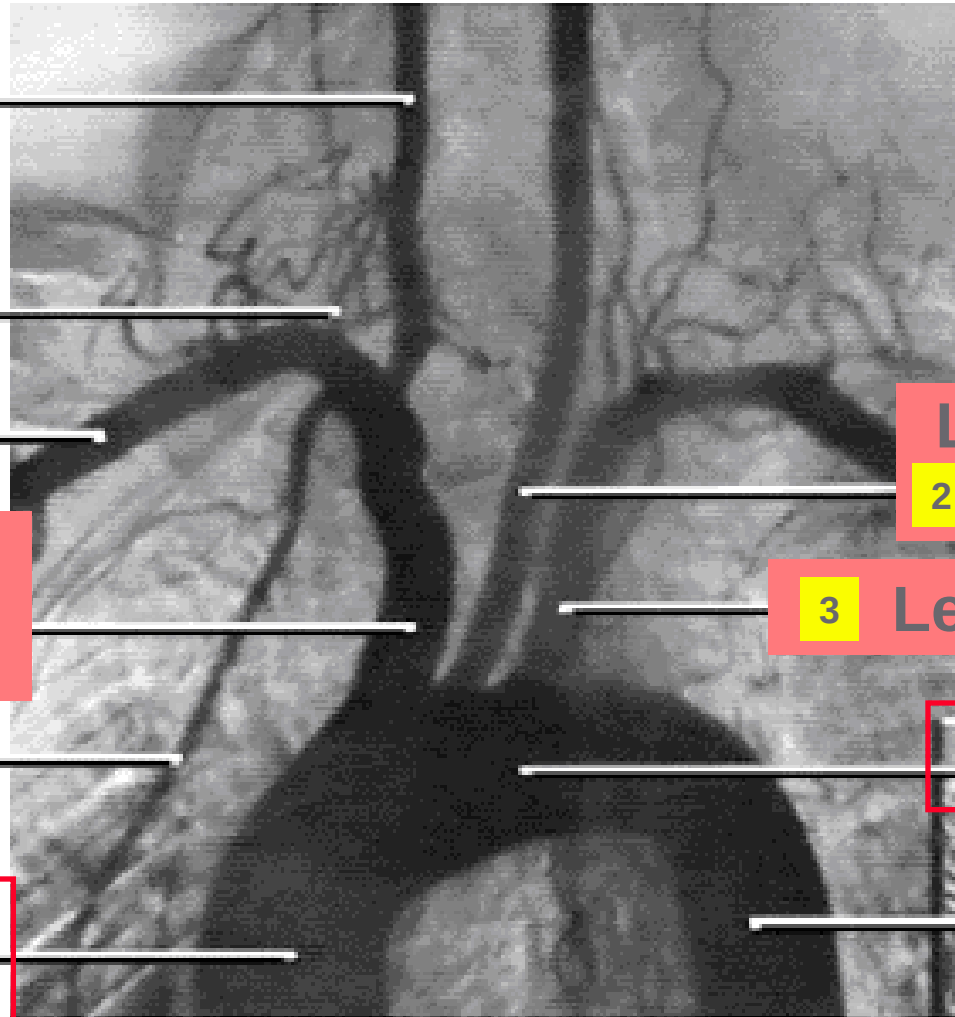
Ascending
aorta

2 Left common
carotid

3 Left subclavian

Aortic arch

Descending
aorta



Cor>Sag -6
>Tra -5

Right Common Carotid

Left Common Carotid

Right Subclavian

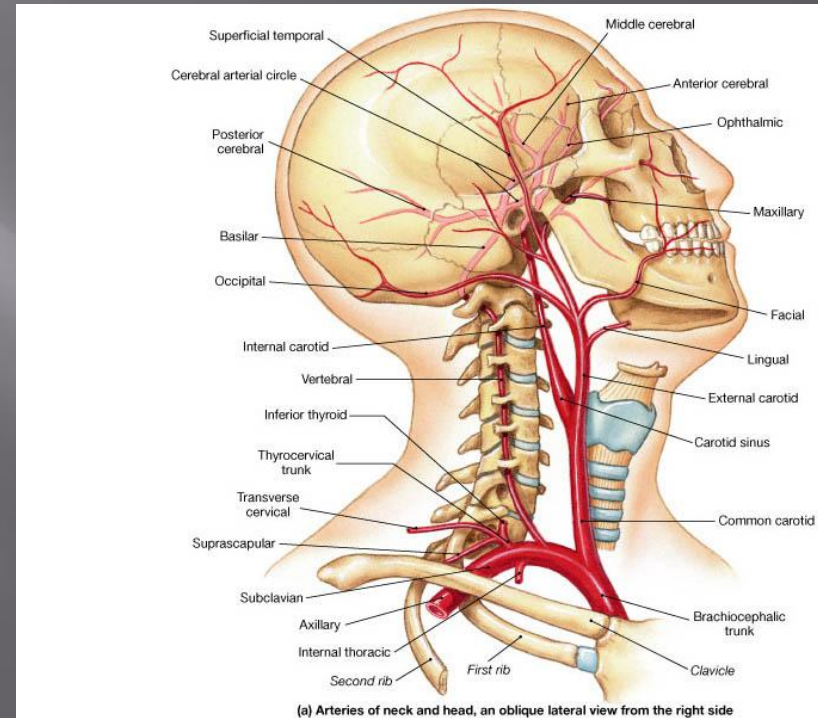
Brachiocephalic Trunk

Left Subclavian



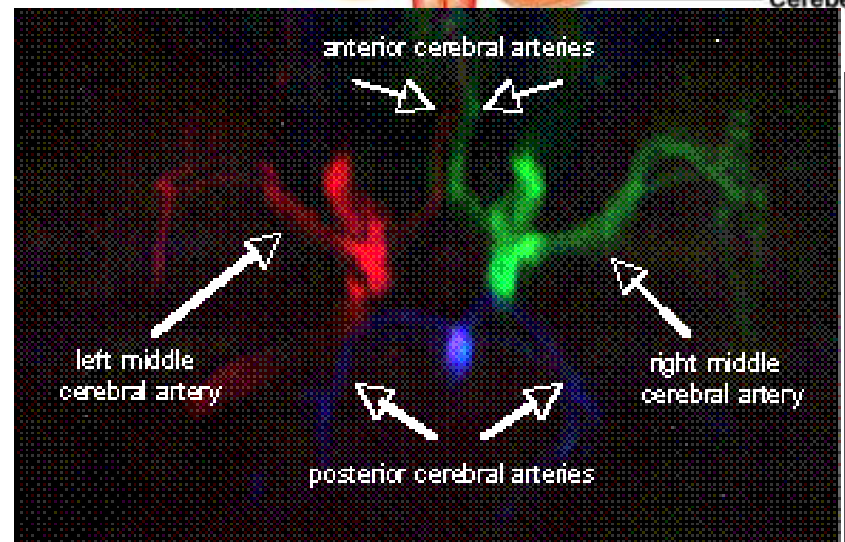
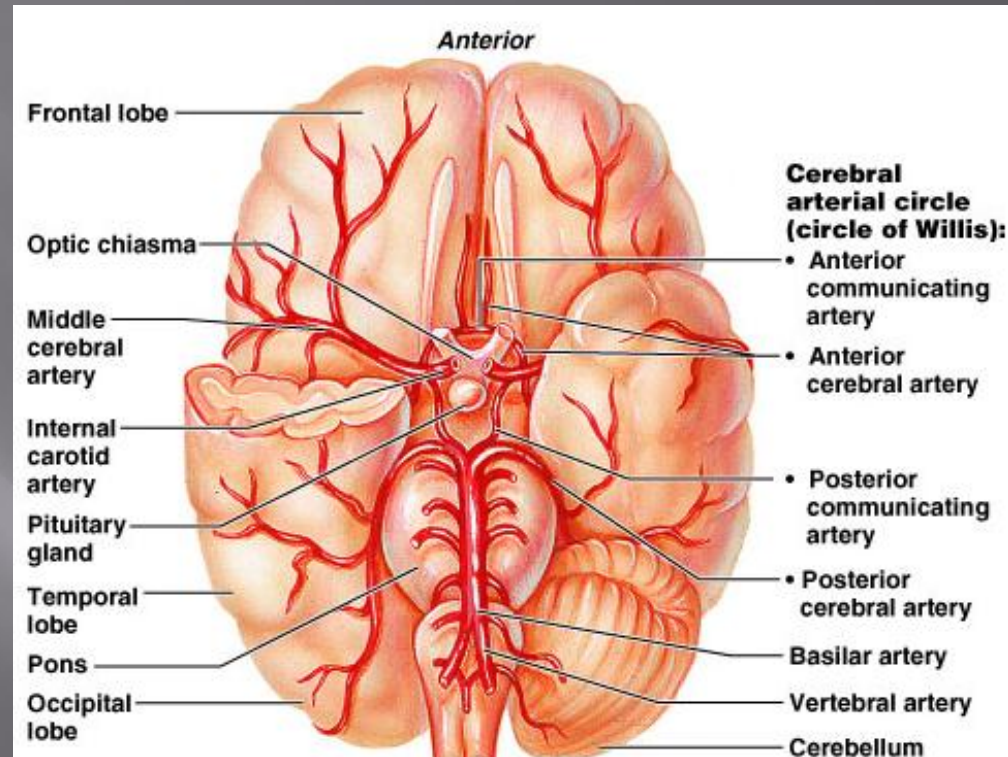
Arteries to the Head

- ▣ Common carotid (2)
- ▣ Vertebral Artery (2)
 - Through the transverse foramina
- ▣ Basilar Artery (1)
 - Through foramen magnum
- ▣ Circle of Willis

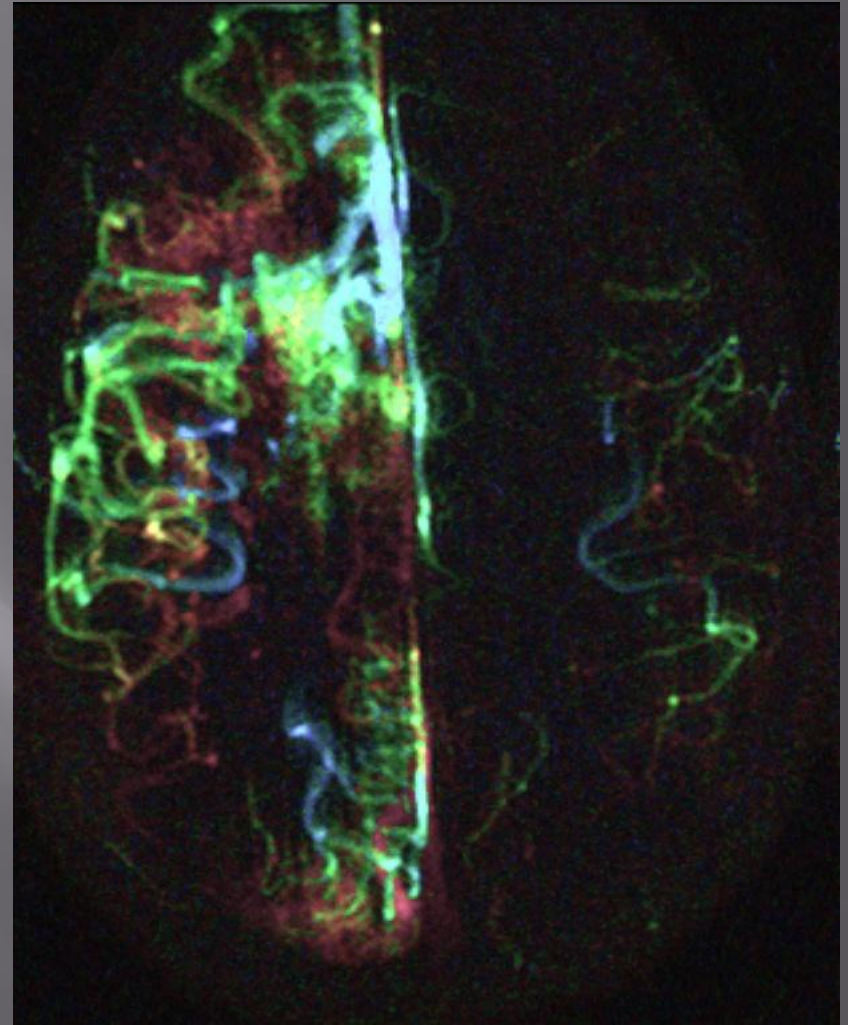


Circle of Willis = Cerebral Arterial Circle

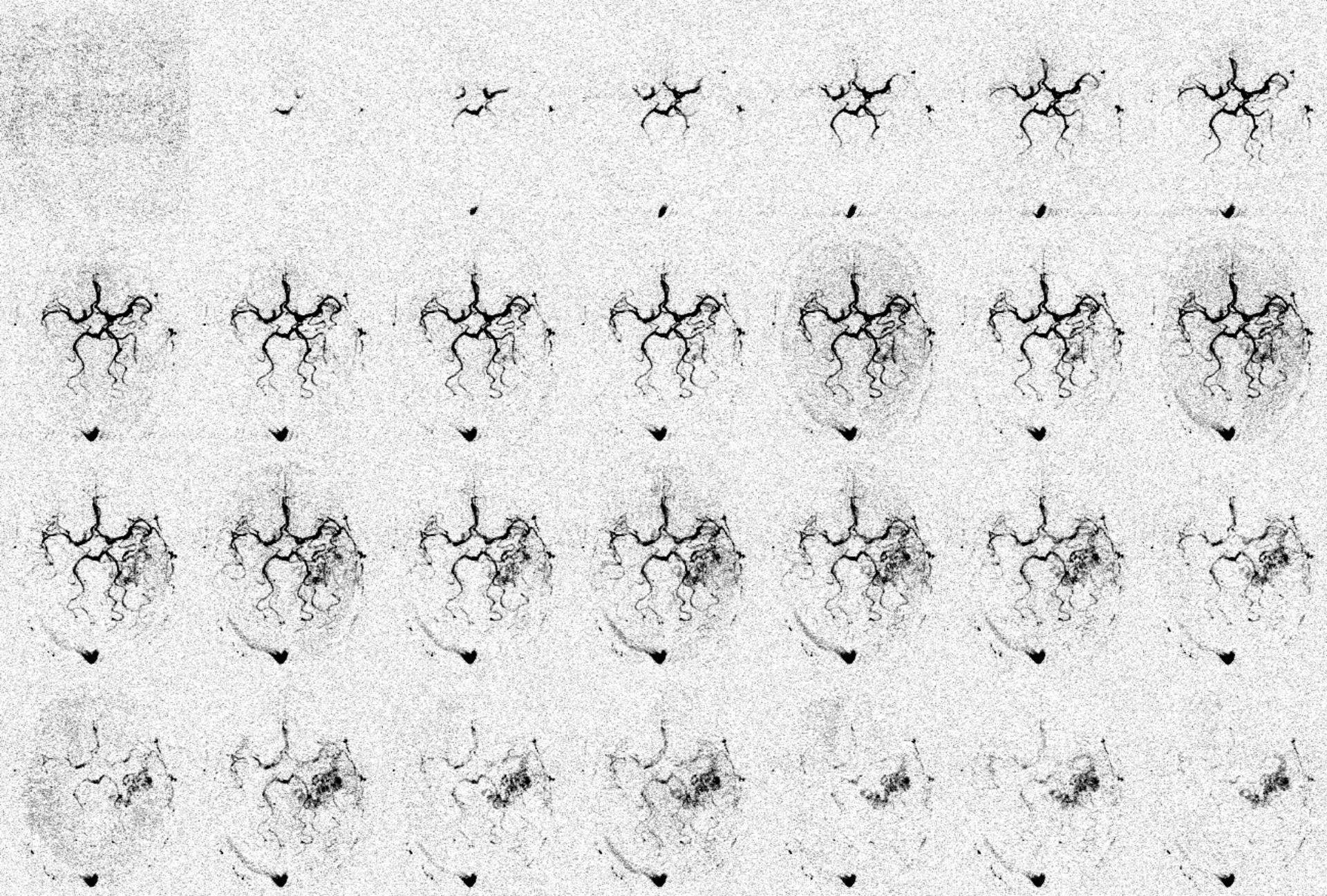
- = Ring of vessels surrounding pituitary gland - supplies cerebrum and cerebellum
- Brain can receive blood from carotid or vertebral or basilar aa.
 - *Collateral circulation*
 - (significance?)



Arteriovenous malformations (AVM) are masses of abnormal blood vessels which grow in the brain.



Dynamic angio

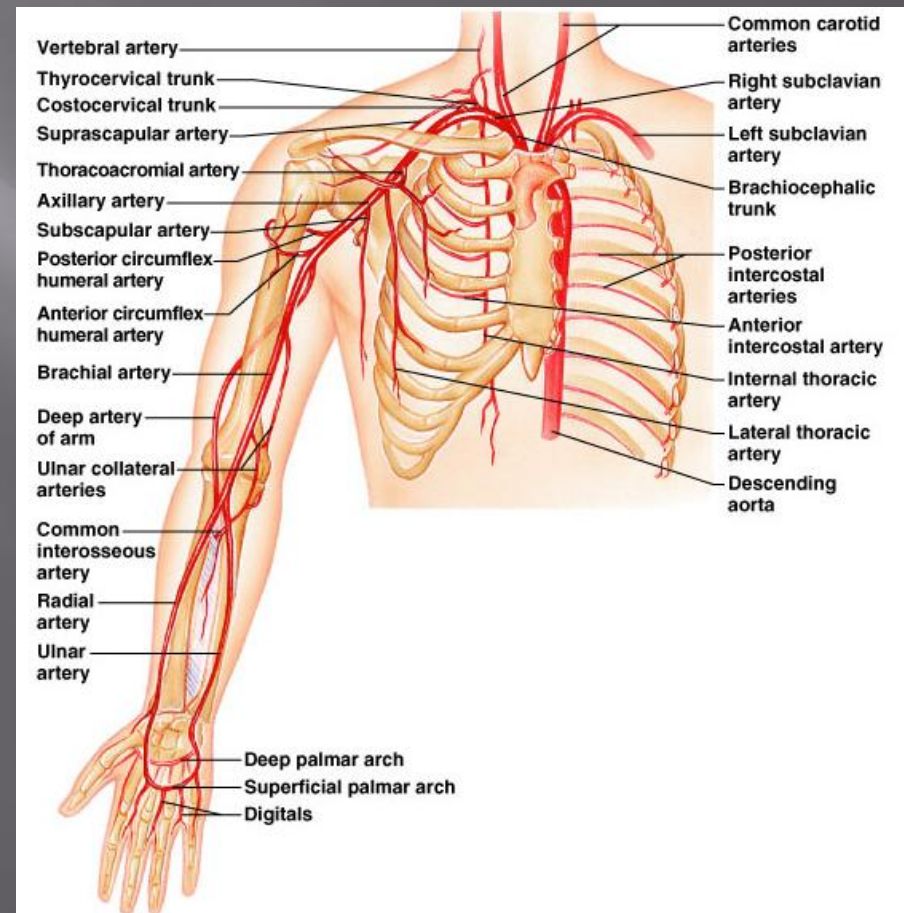


Arteriosclerosis

- ▣ Sclerosis = hardening

Arteries of the Arm

- ▣ Difference Between Right and Left??
- ▣ Subclavian
- ▣ Axillary
- ▣ Brachial
 - Radial
 - Ulnar



The Hand



Ulnar Artery

Radial Artery

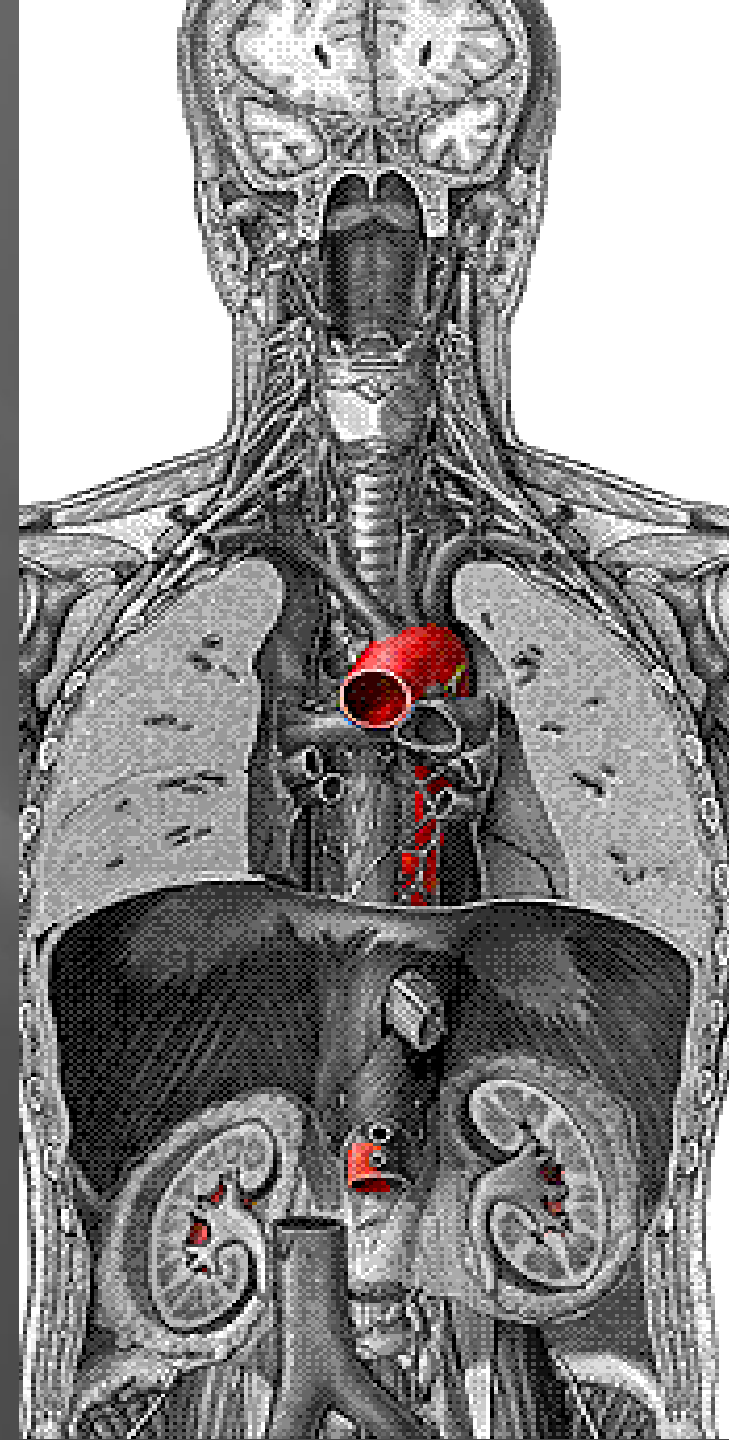
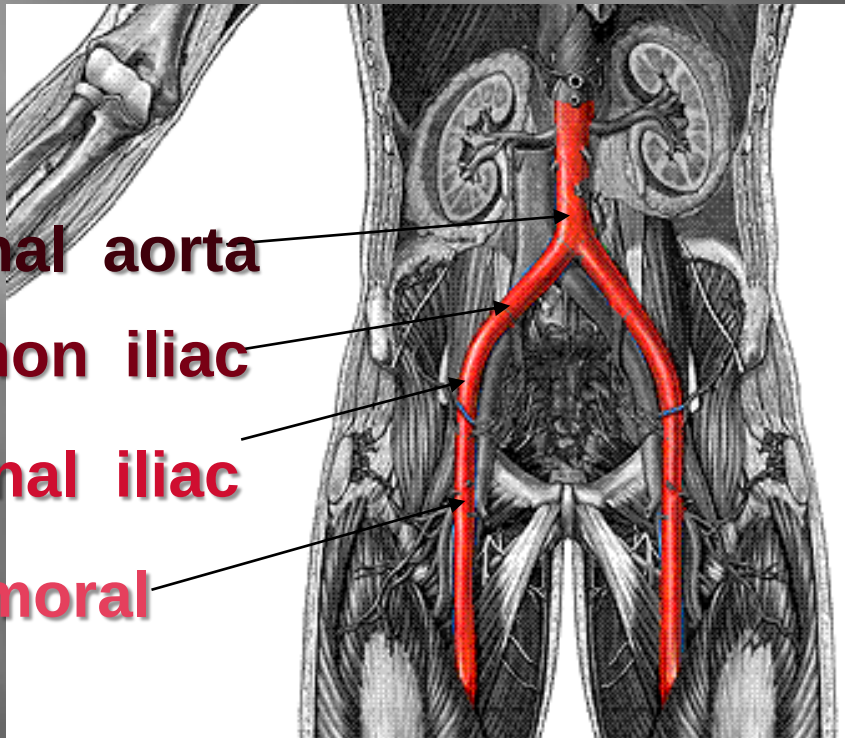
Superficial Palmar Arch

Body Worlds

Descending aorta

Thoracic aorta
Abdominal aorta

Abdominal aorta
Common iliac
External iliac
Femoral



Descending Aorta - Thoracic Area

Bronchial arteries - supply bronchi and lungs

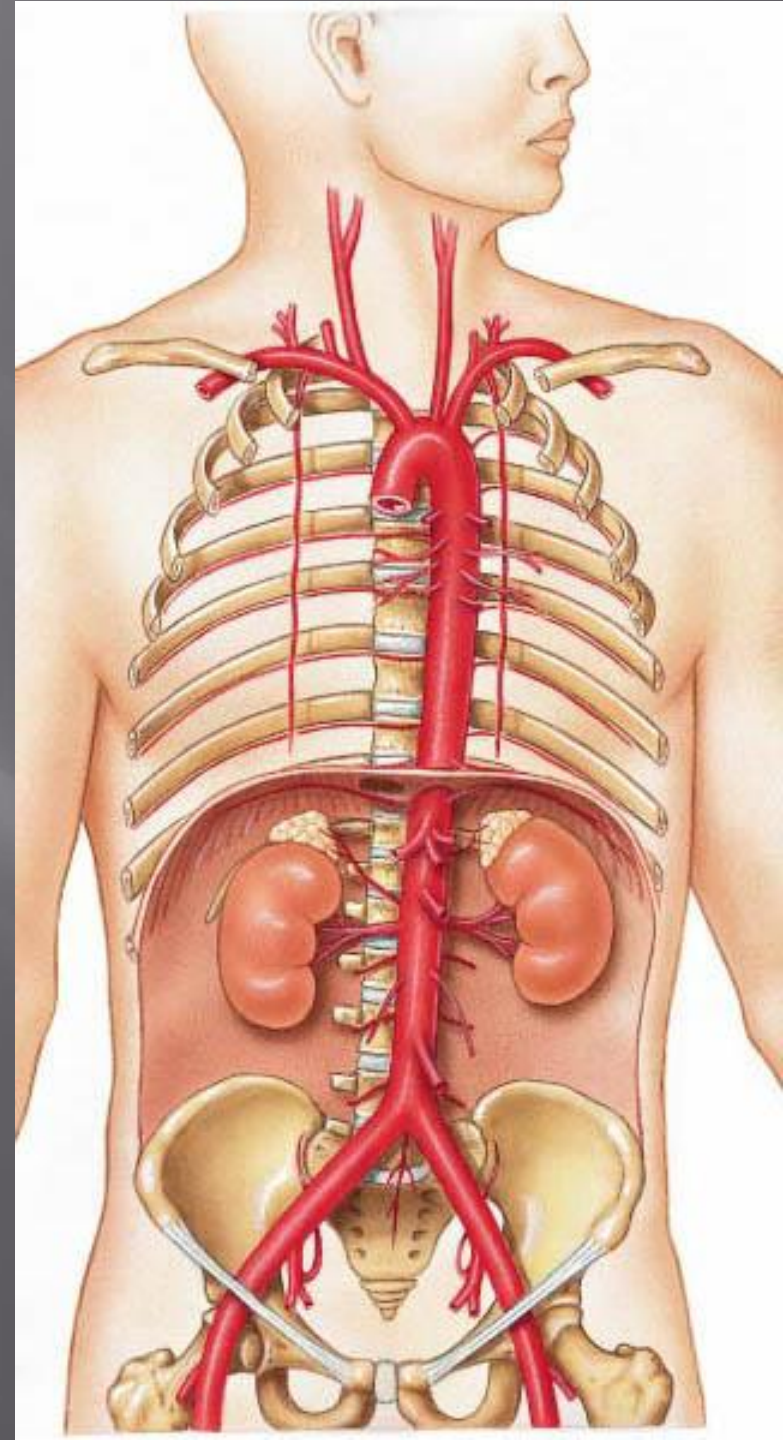
Pericardial arteries - supply pericardium

Mediastinal arteries - supply mediastinal structures

Esophageal arteries - supply esophagus

Paired intercostal arteries- thoracic wall

Superior phrenic arteries - supply diaphragm



Descending Aorta: Abdominal Area

Celiac trunk - 3 branches – to liver, gallbladder, esophagus, stomach, duodenum, pancreas, and spleen

Superior mesenteric – to pancreas and duodenum, small intestine and colon

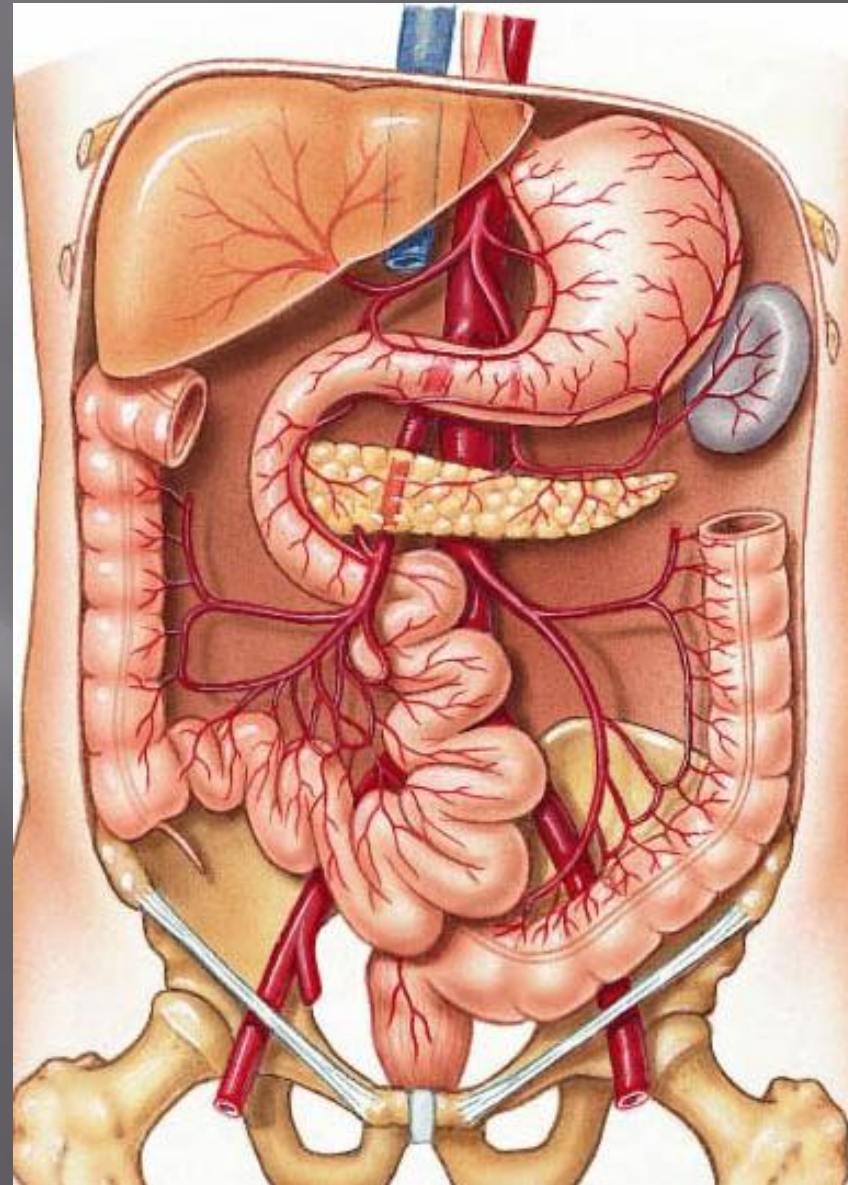
Paired suprarenal - to adrenal glands

Paired renal – to kidneys

Paired gonadal – to testes or ovaries

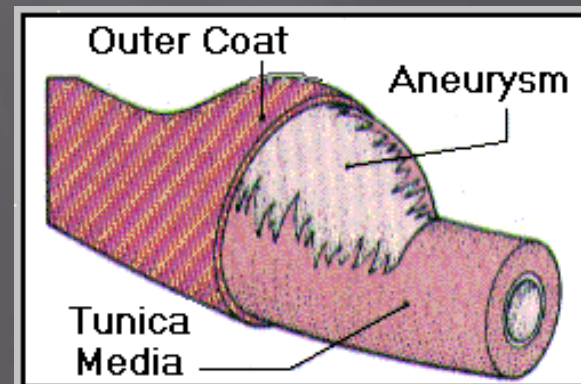
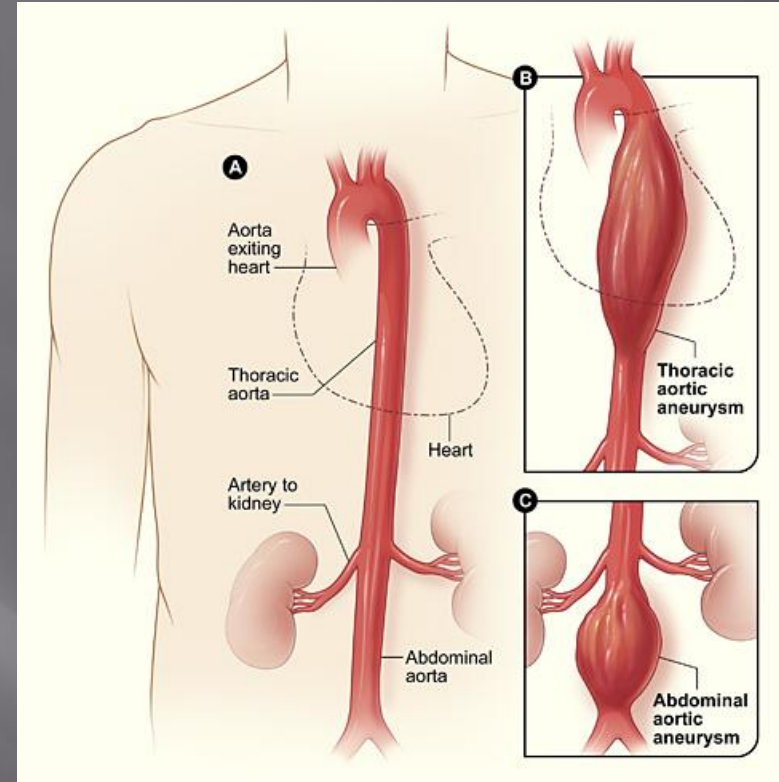
Inferior mesenteric – to terminal colon and rectum

Paired lumbar – to body wall



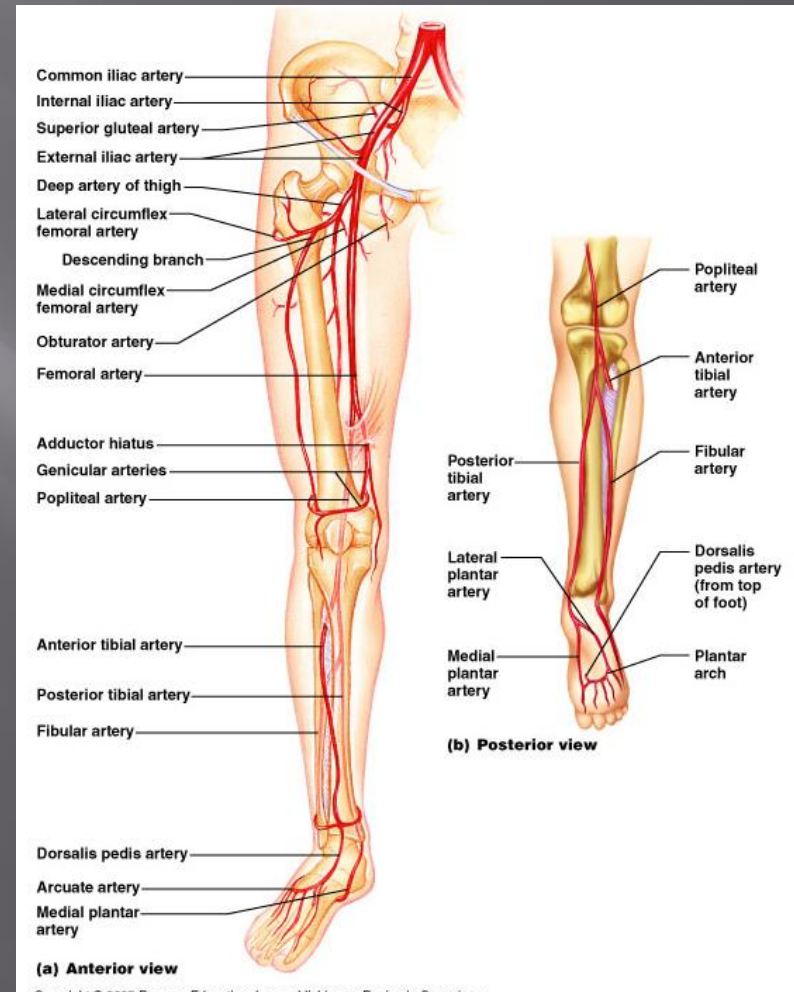
Aortic Aneurysm

- ▣ An aneurysm is a bulging or ballooning of an artery.
- ▣ Often asymptomatic if it grows slowly
- ▣ Weakness in the C.T. wall of the aorta
- ▣ Rupture = ?
- ▣ Treatment is synthetic support of the aorta



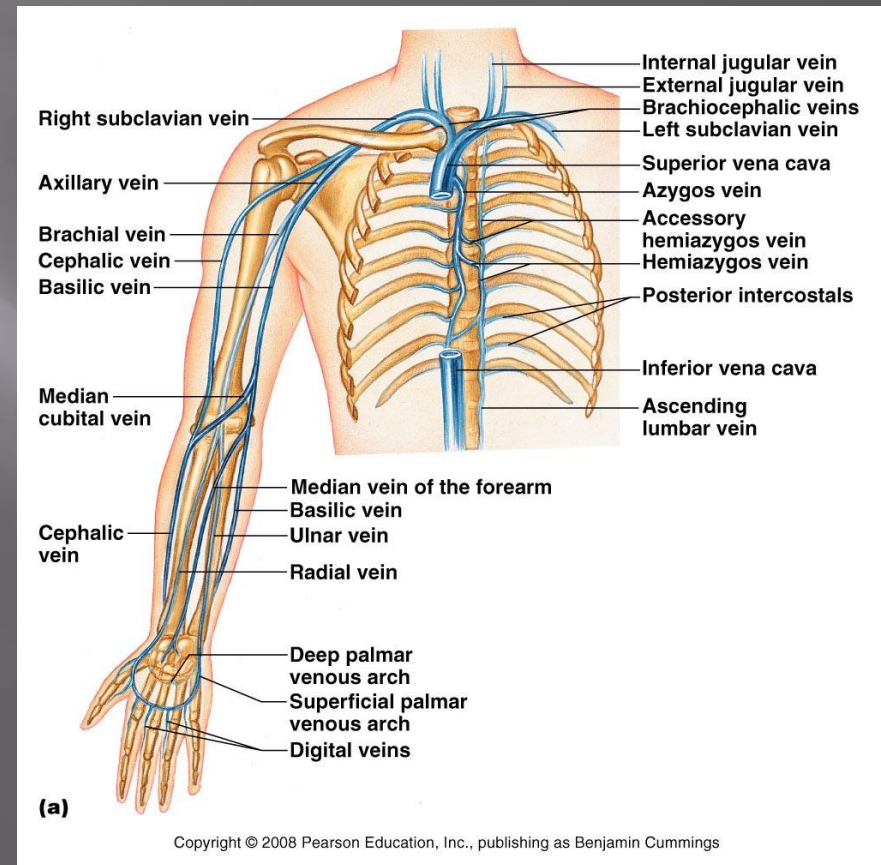
Circulation of the Leg

- ▣ Common Iliac A. and V.
- ▣ External Iliac A. & V.
- ▣ Femoral A. & V.
- ▣ Popliteal A. & V.
 - Anterior Tibial
 - Posterior Tibial
- ▣ Dorsal Pedal A.
 - Pulse checking
- ▣ Great Saphenous V.
 - Used for coronary bypasses
 - Longest vessel



Venous Circulation

- ▣ Mostly parallels arterial circulation
- ▣ Veins are more superficial in limbs
- ▣ Major exception in the abdomen
 - Portal Circulation

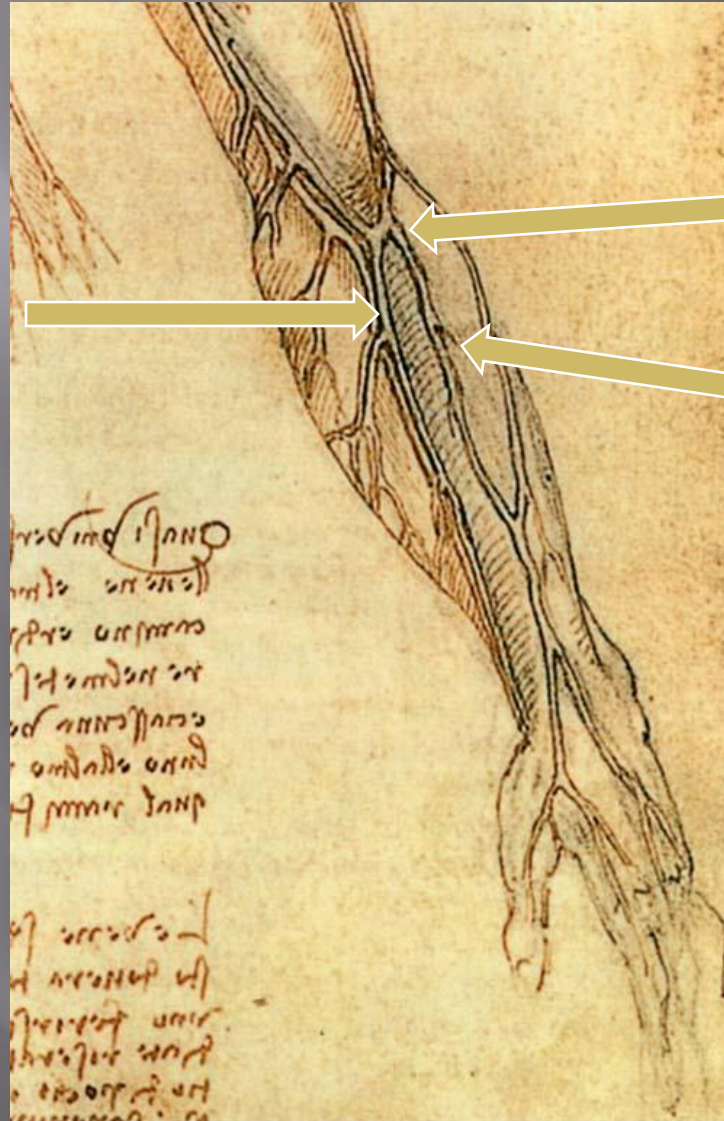


Useful Superficial Veins

Basilic v.

Median cubital v.

Cephalic v.



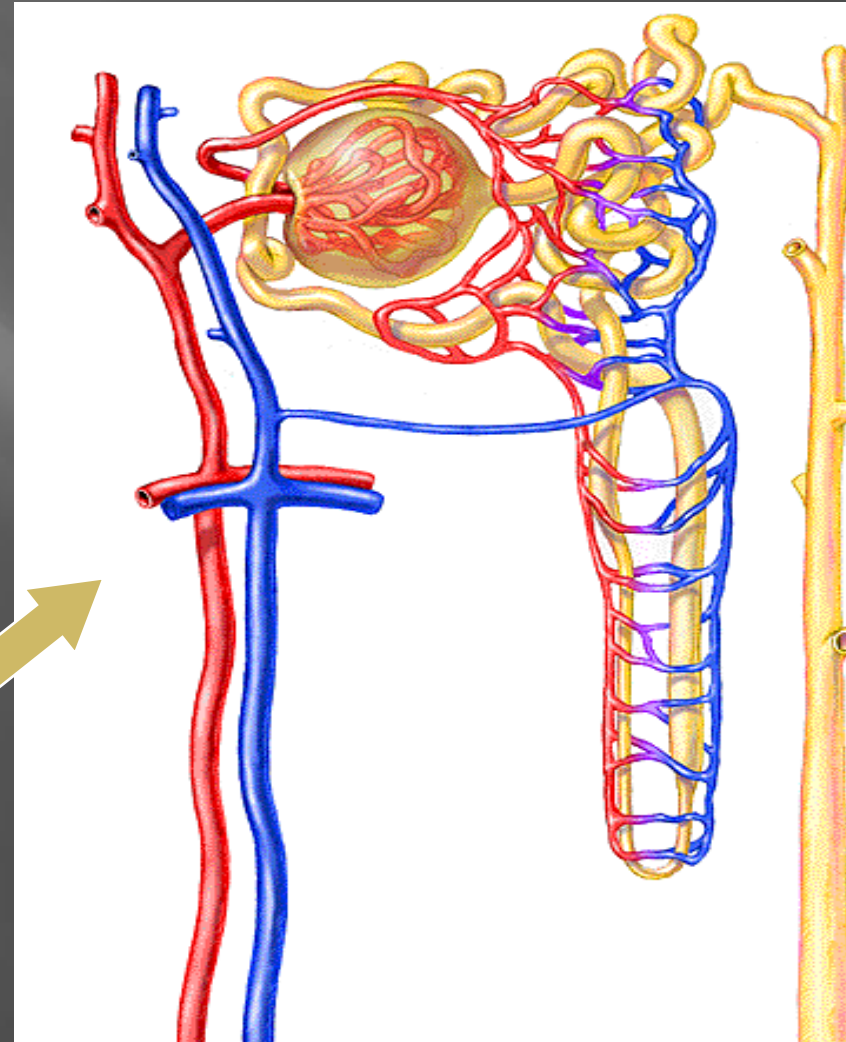
See Fig. 20.18

Portal Systems

Normal Blood Flow: From artery to capillary bed to vein and back to heart

3 exceptions: from artery to capillary to artery (or venule) to capillary to vein

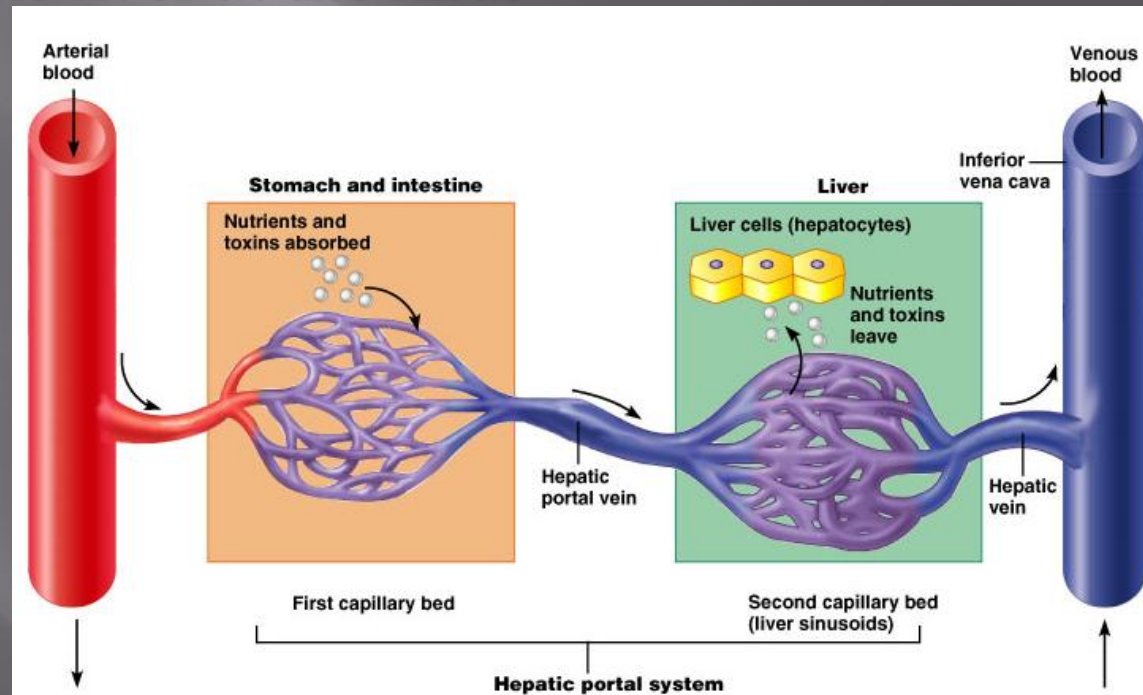
- ▣ Hypophysis
- ▣ Liver
- ▣ In kidney nephrons

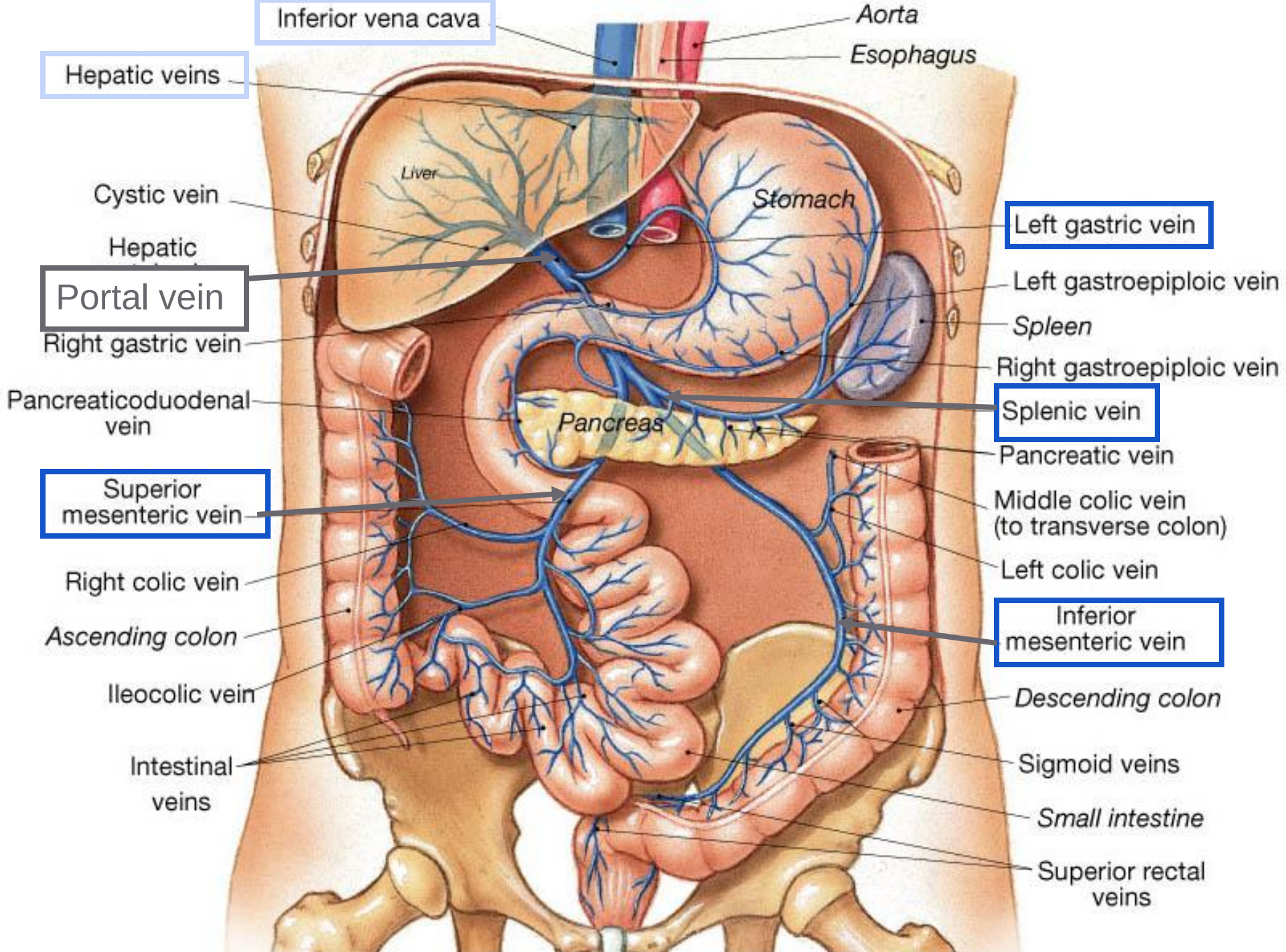


Portal Circulation

- Venous return from the intestine is carried to the liver via the **Portal Vein**
- Most nutrients (not fat) are carried by the portal vein
- Portal vein enters the liver at the hilus

Fig. 20.21 (a)





Varicose Veins

- ▣ Page 562
- ▣ ↑ BP in legs
- ▣ Venous dilation
- ▣ Pooling
- ▣ May be painful and/or thrombogenic



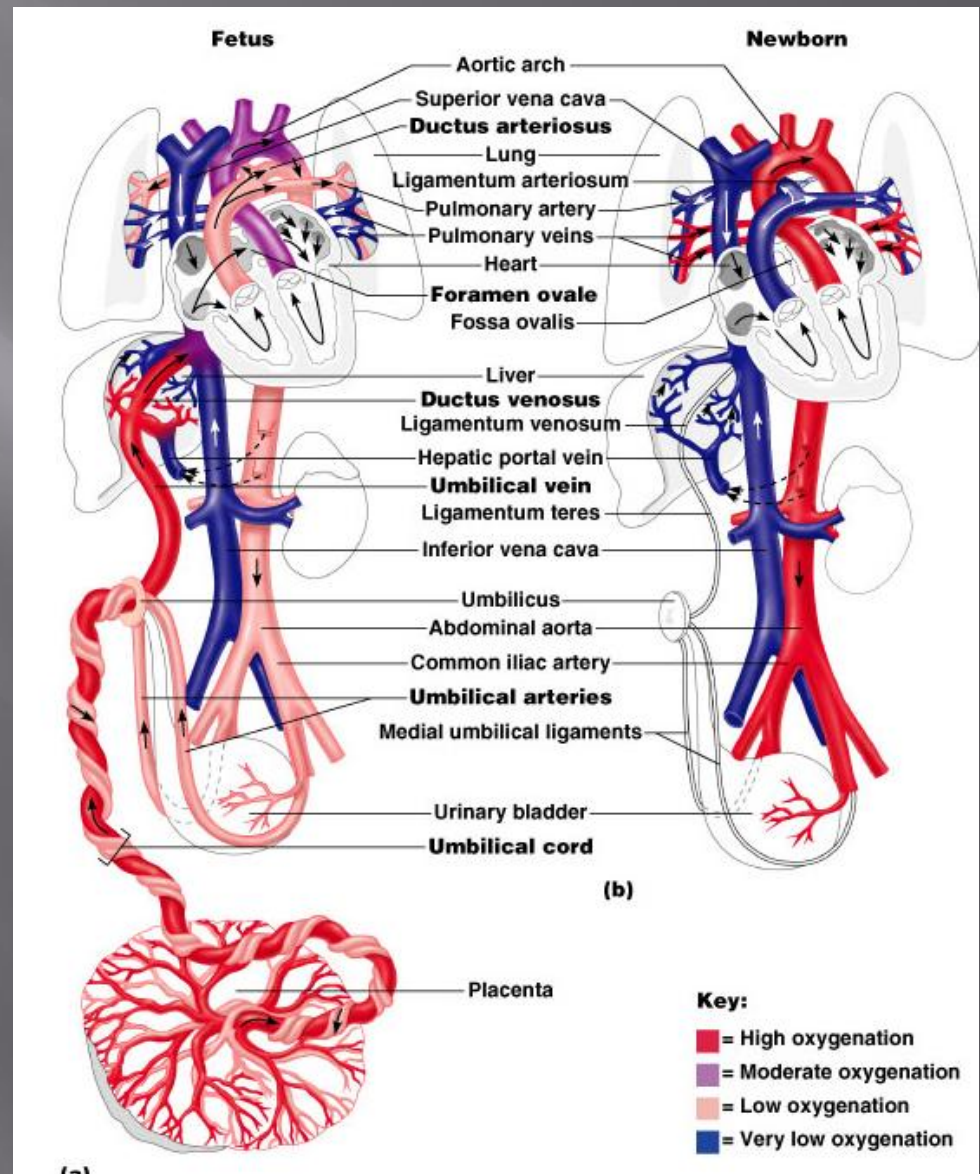
Fetal circulation

During fetal life, all oxygen and nutrition comes not from the intestine and lungs, but from the placenta.

The fetus has different circulatory pathways to accommodate these different needs.

These pathways must change AT the time of birth.

Figure 20.24



Circulation Changes AT Birth

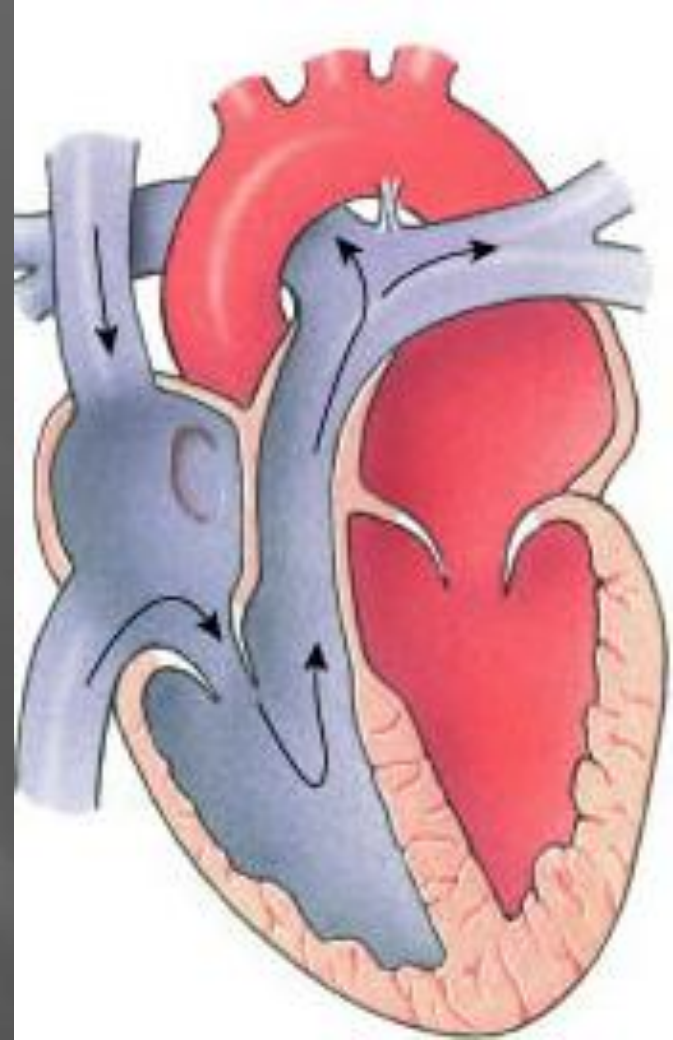
No blood coming from placenta

Ductus venosus becomes **ligamentum venosus** (=ligamentum teres)

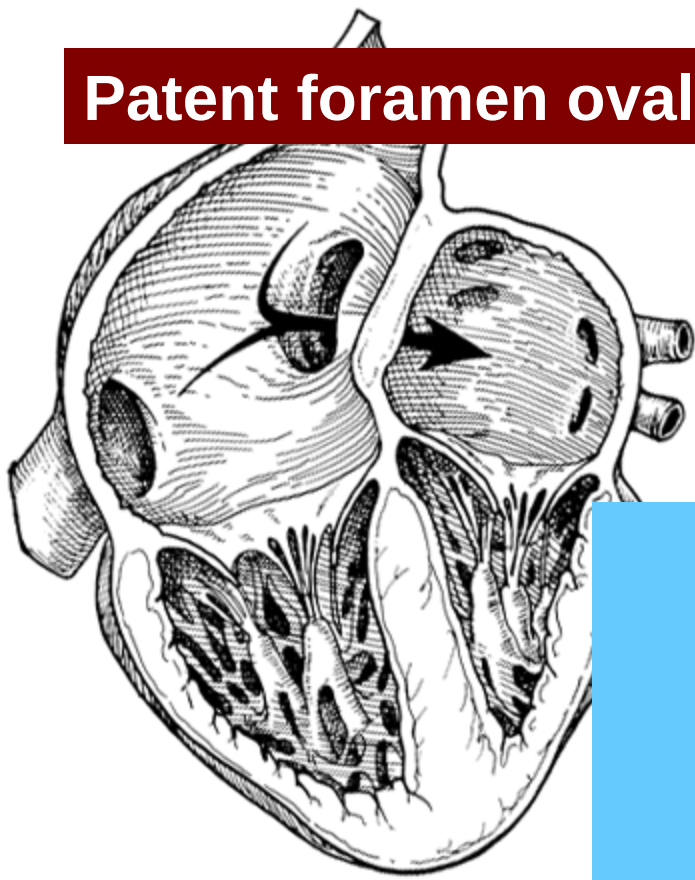
Foramen ovale closes & becomes **fossa ovale**

Ductus arteriosus closes and becomes **ligamentum arteriosum**

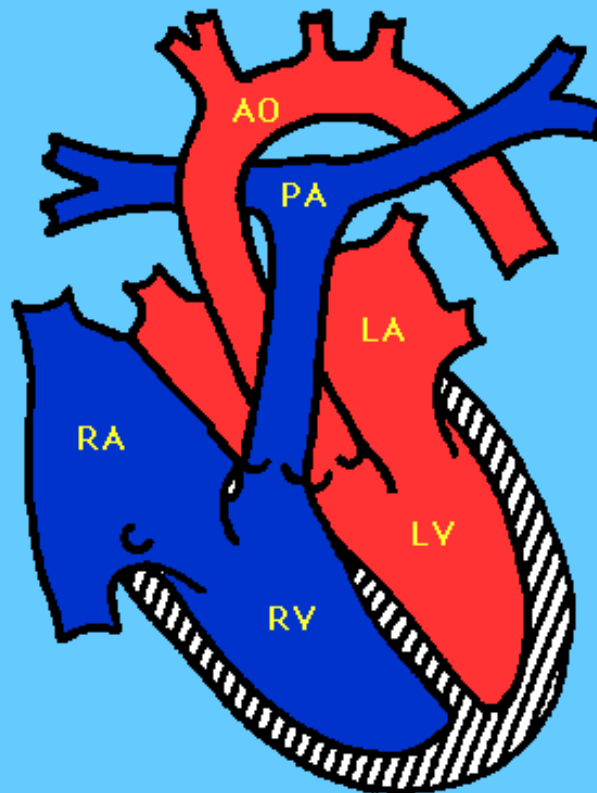
Umbilical vein and arteries degenerate



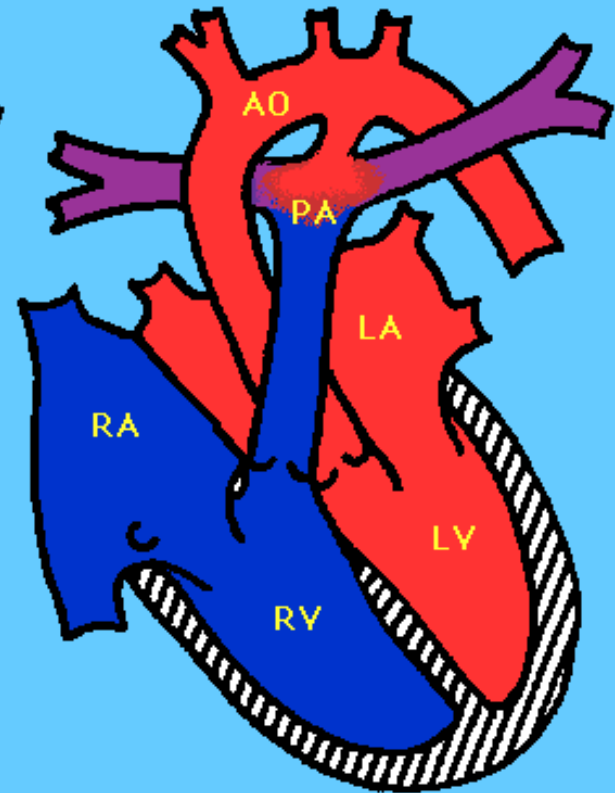
Patent foramen ovale



Patent Ductus Arteriosus



Normal



Patent Ductus Arteriosus

